Rec'd PCT/PTO 24 MAR 2005

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : D21F 1/52 — A1

(11) International Publication Number: WO 98/29600

(43) International Publication Date: 9 July 1998 (09.07.98)

(21) International Application Number: PCT/FI97/00826

(22) International Filing Date: 22 December 1997 (22.12.97)

(30) Priority Data:
965277 31 December 1996 (31.12.96) FI

(71) Applicant: VALMET CORPORATION [FI/FI]; Panuntie 6, FIN-00620 Helsinki (FI).

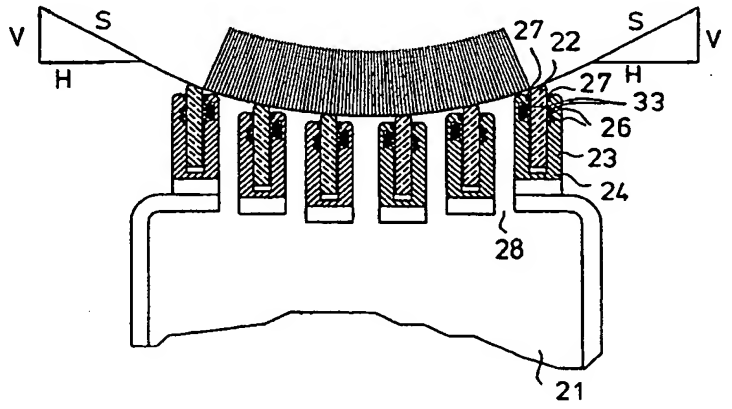
(72) Inventors: SNELLMAN, Jorma; Tupakatu 3, FIN-40500 Jyväskylä (FI). POIKOLAINEN, Antti; Ritopohjantie 5, FIN-40250 Jyväskylä (FI). PUURTINEN, Ari; Esankatu 28, FIN-40700 Jyväskylä (FI). SALMINEN, Samppa, J.; Roninmäentie 20, FIN-40500 Jyväskylä (FI).

(74) Agent: FORSSÉN & SALOMAA OY; Yrjönkatu 30, FIN-00100 Helsinki (FI).

(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: SUCTION BOX IN A PAPER MACHINE AND METHOD IN THE SUCTION BOX IN A PAPER MACHINE



(57) Abstract

The invention concerns a suction box in a paper machine, comprising a vacuum chamber (21), a deck or a number of substantially U-section holders (24) open towards the wire or equivalent, and a number of ribs (22), which have been fitted in said deck or in said holders (24) so that they can be loaded against the wire or equivalent by means of loading means (23). At least in a running situation, the deck of the suction box (20) or the position of the ribs (22) is curved so that the wire tension lowers the normal force which is produced by the vacuum present in the suction box (20) and which is effective between the wire and the deck/ribs (22). Further, the invention also concerns a method in a suction box in a paper machine, wherein a vacuum is formed in the vacuum chamber (21) of the suction box (20) and, during formation of the vacuum, the deck and/or the ribs (22) is/are pressed against the wire or equivalent. In the method, at least in a running situation, the curve form of the deck of the suction box (20) or of the position of the ribs (22) is such that the wire tension lowers the normal force which is produced by the vacuum present in the suction box (20) and which is effective between the wire and the deck/ribs (22).

BEST AVAILABLE COPY

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

Suction box in a paper machine and method in the suction box in a paper machine

The invention concerns a suction box in a paper machine, comprising a vacuum chamber, a deck or a number of substantially U-section holders open towards the wire or equivalent, and a number of ribs, which have been fitted in said deck or in said holders so that they can be loaded against the wire or equivalent by means of loading means.

The invention also concerns a method in a suction box in a paper machine, wherein a vacuum is formed in the vacuum chamber of the suction box and, during formation of the vacuum, the deck and/or the ribs is/are pressed against the wire or equivalent.

In connection with suction boxes in paper machines, a problem has been high consumption of power and rapid wear of the wires. The ribs or the common deck on a suction box is/are placed against the wire, in which connection, by the effect of the vacuum in the suction box, a force is produced between the wire and the ribs, which force is divided into normal force and friction force. The friction force between the rib and the wire increases as a function of the vacuum in the suction box and of the speed of the wire, in which connection intensive wear of the wire arises. This also increases the requirement of power. In solutions known from the prior art, as one solution of these problems, in stead of suction boxes, suction rolls have been used, in whose connection, however, the high power loss arising from pumping has been problematic. Likewise, the cleaning costs and the high costs of servicing and manufacture of suction rolls have been a drawback in relation to said solution. Also, when the speed becomes high, the consumption of power is increased to a great extent, and so also the wear, for which reasons solutions are needed for these problems.

The object of the present invention is to provide a solution for elimination of the high consumption of power of a suction box in a paper machine and for prevention of the rapid wear of the wires.

In view of achieving the objectives of the invention, the suction box in accordance with the invention is mainly characterized in that, at least in a running situation, the deck of the suction box or the position of the ribs is curved so that the wire tension lowers the normal force which is produced by the vacuum present in the suction box and which is effective between the wire and the deck/ribs.

The method in accordance with the invention is mainly characterized in that, in the method, at least in a running situation, the curve form of the deck of the suction box or of the position of the ribs is such that the wire tension lowers the normal force which is produced by the vacuum present in the suction box and which is effective between the wire and the deck/ribs.

In the arrangement in accordance with the invention, the friction between the ribs or the common deck of the suction box and the wire is lower or substantially eliminated, in which connection the consumption of power is lowered and the wear of the wires becomes slower. In accordance with the invention, in a normal running situation, the common position formed by the ribs of the suction box or the deck of the suction box is curved (concave), so that the wire tension reduces the normal force which is produced by the vacuum and which is present between the wire and the ribs/deck. The curve form of the deck/ribs is produced either by locking the ribs in a curved (concave) form or by already making the deck of the suction box / the position of the ribs curved (concave) in the desired way in advance.

An embodiment of the invention in which the deck of the suction box is fixed and curved (concave) in advance provides a lowering of the friction and, thus, the advantages mentioned above. The cost of manufacture of such an embodiment is quite favourable.

With an embodiment of the invention in which the ribs are locked in the desired position and in which a sealing free of contact is achieved, a lower friction force is also achieved, in which case the requirement of power is lowered and the wear of the wire is reduced. With the arrangement in accordance with the invention, the wire can be bent into a curved form of a rope curve. According to a favourable additional feature of the invention, it is possible to lock the ribs on the suction box either so that they contact the wire or so that a desired normal force is produced between the rib and the wire, whereby an increased reliability of running is achieved.

Further advantages and characteristic features of the invention will come out from the following detailed description of the invention.

In the following, the invention will be described by way of example with reference to the figures in the accompanying drawing.

Figures 1A—1B are schematic illustrations of a suction box as fitted between two rolls, Fig. 1A when the vacuum has not been switched on or when the vacuum has been switched on but the ribs are not yet in the running position, and Fig. 1B when the vacuum has been switched on and when the ribs have been shifted to the running position.

Figures 2A—2B are schematic illustrations of a suction box placed on a straight run of the wire, Fig. 2A when the vacuum has not been switched on or when the vacuum has been switched on but the suction box is not yet in the running position, and Fig. 2B when the vacuum has been switched on and when the suction box has been shifted to the running position.

Figures 3A—3C are schematic illustrations of a suction box fitted opposite to a roll in a situation in which two wires run over the roll, in Fig. 3A when the vacuum has not been switched on or when the vacuum has been switched on but the suction box is not yet in the running position, in Fig. 3B when the vacuum has been switched on

and when the suction box has been shifted into a running position, and in Fig. 3C with a vacuum level higher than that in the preceding Fig. 3B.

Figures 4A—4B are schematic illustrations of the forces effective in connection with a suction box in different situations; in Fig. 4A there is no vacuum in the suction box and the ribs have not been locked, in Fig. 4B a vacuum is effective in the suction box and the ribs have not been locked, in Fig. 4C the vacuum of the suction box is effective under the ribs and the ribs have not been locked, and in Fig. 4D the vacuum of the suction box is effective under the ribs and the ribs have been locked.

Figures 5A—5B are schematic illustrations of the sealing of the ends of the suction box, Fig. 5A when there is no vacuum in the suction box, and Fig. 5B when there is a vacuum in the suction box.

Figure 6 is a schematic illustration of the vacuum load applied to the wire and of the wire tension in a case of an exemplifying embodiment of the arrangement in accordance with the invention.

Figure 7A is a schematic sectional view of a suction box in accordance with a second exemplifying embodiment of the invention, Figure 7B an illustration when the vacuum has not been switched on or when the vacuum has been switched on but the suction box is not yet in the running position, and Figure 7C is an illustration with the vacuum switched on and with the suction box shifted to the running position.

Figure 8A illustrates a favourable location of the suction box opposite to an open roll, preferably a suction roll provided with an inside suction box.

Figure 8B illustrates the operation of a suction box placed in the position shown in Fig. 8A when the ribs are adjusted so that a desired gap E is produced between the ribs and the face of the pick-up roll 100 placed opposite to the ribs, in which connection rewetting of the web W is prevented.

Figure 8C shows an embodiment in which the web W is passed into the couch pit and in which embodiment the pick-up roll has no suction, but there is suction in the suction box.

In the exemplifying embodiment shown in Figs. 1A—1B, the suction box 20 has been fitted in its place between two rolls 12,13, and the suction box 20 is provided with mobile ribs 22. Besides the rolls 12 and 13, the wire loop 10 also runs over the rolls 11 and 14. In the situation shown in Fig. 1A there is no vacuum in the vacuum chamber 21 of the suction box 20, in which case the wire 10 runs straight and the ribs 22 are loaded against the wire. A situation as shown in Fig. 1B is reached when a vacuum is applied to the suction chamber 21 in the suction box 20, in which connection the vacuum pulls the wire 10 into a curve form at the suction box 20 and the ribs 22 are retracted into their holders 24 when the loading pressure of the ribs 22 is eliminated. When the vacuum level in the suction chamber 21 and the distance of the wire 10 from the suction box 20 are as desired, for example do not change any more, the ribs 22 of the suction box 20 are locked by means of a locking mechanism, which will be described in more detail later, in their place most appropriately in a position in which a small gap remains between the wire 10 and the ribs 22, in which case a sealing free of contact is obtained. In the exemplifying embodiment shown in Figs. 1A and 1B, the suction box 20 is placed in a fixed position, because there are the rolls 12,13 at a very short distance at both sides of the suction box 20. In such a case, the inlet angle and the outlet angle of the wire 10 in relation to the suction box 20 can be made sufficiently large.

Thus, when the situations in Figs. 1A and 1B are compared, it is noticed that the vacuum pulls the wire into a curve form, whose shape corresponds to the shape of a rope curve, i.e. of a cosine hyperbola. In such a case a situation is reached in which the load per unit of length is even, in which case the wire 10 has a tension, and the vertical component of force carries the load and reduces the normal force, in which situation the ribs 22 can be separated from the wire 10, without substantial reduction of the vacuum, and locked in their positions, cf. Fig. 6. The curve form of the wire depends on the vacuum that is used and on the wire tension. Thus, the

ribs 22 on the suction box 20 are locked when the vacuum level in the suction box 20 and the distance of the wire 10 from the suction box 20 do not change any more. At the same time, the locking mechanism detaches the ribs 22 slightly apart from the wire without substantial lowering of the vacuum level, in which connection the consumption of power and the wear of the wire are reduced.

Figs. 2A and 2B show an embodiment in which the suction box 20 is placed on a straight run of the wire 10A between the rolls 12A and 14A. Figs. 2A and 2B also indicate the wire circulation 10A, the roll 11A, and the press felt 15A and the pick-up roll 16A. In this exemplifying embodiment the suction box 20 is displaceable, which is indicated by the arrow S. In the situation shown in Fig. 2A there is no vacuum in the suction chamber 21 of the suction box 20, or the vacuum has been switched on, but the suction box is not yet in the running position, and Fig. 2B shows a situation in which there is a vacuum in the suction chamber 21, and the suction box has been shifted into the running position. When the suction box 20 is displaced in the direction of the arrow S, the inlet and outlet angles of the wire 10A into and out of the area of the ribs 22 on the suction box can be brought to the desired level so that the desired curve form is obtained. The operation of the ribs 22 on the suction box 20 is similar to that described above and also to what will be described later in relation to Figs. 4A...4D.

In the exemplifying embodiment shown in Figs. 3A—3B, the suction box 20 is placed opposite to the roll 18B, around which roll two wires 10B,17B run at the suction box 20. The roll 18B is open, so that, through it, it is possible to produce a suction effect, for example a grooved roll or some other hollow-faced roll. The pick-up felt of the press section is denoted with the reference numeral 15B, and the related pick-up roll with the reference 16B. The wire 10B runs over the rolls 11B and the suction roll 14B. Of the rolls shown in the figures, the wire 17B runs over the roll 18B. In the exemplifying embodiment shown in Figs. 3A...3C, the suction box 20 is displaceable, which is indicated by the arrow S. In the situation as shown in Fig. 3A, there is no vacuum effective in the suction chamber 21 of the suction box 20, or a vacuum has been switched on, but the suction box is not yet in the

running position, in the exemplifying embodiment shown in Fig. 3B a certain vacuum is effective in the suction chamber, and a certain wire tension is applied. In Fig. 3C the vacuum is higher than the vacuum in Fig. 3B, and the wire tension is the same as in Fig. 3B, in which case the wire 10B is bent to a greater extent into curve form and the suction box 20 has been shifted further apart from the roll 18B. The curve form produced by means of the suction box 20 depends on the wire 10B tension and on the vacuum employed in the suction box 20.

In the following, in relation to Figs. 4A—4D, the stages taking place in the arrangement in accordance with the invention will be described in more detail. The effect of the suction chamber 21 of the suction box 20 is transferred to the wire through the gaps 28. The ribs 22 are attached to their holders 24, preferably into a U-section space made into the holder 24. At the bottom of the U-section space there is a loading space 23, in which there may be, for example, a loading hose (not shown in the figure). The loading hose used for locking is denoted with the reference numeral 25, and the spring members of the rib 22 with the reference numeral 26, and the seals in relation to the holder 24 with the reference numeral 27. The locking ribs of the ribs 22 are denoted with the reference numeral 33.

In situations as illustrated in Figs. 4A and 4B, the ribs 22 have not been locked in their position in their holders 24. In the situation shown in Fig. 4A, there is no vacuum in the suction chamber 21, and in the loading space 23 below the ribs 22 there is a loading pressure, in which case the ribs 22 are pressed against the wire. In Fig. 4B a vacuum is effective in the suction box 21, but a normal atmospheric pressure is effective in the loading space 23 of the ribs 22, in which case the wire is positioned in a curve form similar to a rope curve towards the suction box 20, and the difference in pressure between the lower face and the upper face of the rib keeps the ribs 22 in contact with the wire, in which connection the force zone F is divided into sectors and in which connection no force is effective at the ribs 22, because the loading space of the ribs is at a normal atmospheric pressure.

In Fig. 4C, in the loading spaces 23 of the ribs 22, the vacuum of the suction box 20 is effective, in which case the ribs 22 do not press the wire, and the force zone F is continuous. In Fig. 4D, the vacuum of the suction chamber 21 of the suction box 20 is effective in the loading space 23 below the ribs 22, and the ribs 22 have been locked by pressurizing the locking-loading hose 27, in which situation the ribs 22 remain in their place in their holders 24. During locking, the ribs 22 are pressed downwards away from the wire while guided by locking ribs 33 with slanting faces, whereby a sealing free of contact is obtained.

In compliance with what is shown in Figs. 5A—5B, when the suction box 20 is placed, for example, in connection with a roll, the end sealing is arranged, for example, by means of sealing members 31, which are interconnected by means of articulated joints 32 so that the shape of the end sealing 31 complies with the curved form of the wire 10.

Fig. 6 illustrates the vacuum load applied to the wire as well as the wire tension vector S and its vertical component V and horizontal component H. As is seen from the figure, the load per unit of length is even, in which connection the wire 10 has a tension and the vertical force component V carries the load and lowers the normal force, in which case the ribs 22 can be separated from the wire 10 with no substantial lowering of the vacuum. In accordance with the invention, the ribs can be locked in the desired position, for example in a contact-free position or, for example, in a position in which the desired normal force is effective, whereby an increased reliability of running is achieved.

In the exemplifying embodiment of the invention shown in Fig. 7A, the deck 29' of the suction box 20' is fixed and ready-made in the desired curved (concave) form, in which case the ribs 22' are in a similar curved form. Figs. 7B—7C show a suction box similar to that shown in Fig. 7A placed opposite to a roll in cases corresponding to Figs. 3A—3B. In Figs. 7B—7C the same reference numerals are used for corresponding parts, compared with Figs. 3A and 3B. In the exemplifying embodiment shown in Figs. 7B—7C, the suction box 20' is placed opposite to the

roll 18B, around which roll two wires 10B,17B run at the suction box 20'. The roll 18B is open, so that a suction effect can be produced through it, for example a grooved roll or some other hollow-faced roll. The pick-up felt of the press section is denoted with the reference numeral 15B, and the related pick-up roll with the reference 16B. The wire 10B runs over the rolls 11B and over the suction roll 14B. Of the rolls shown in the figures, the wire 17B runs over the roll 18B. In the exemplifying embodiment shown in Figs. 7B—7C, the suction box 20' is displaceable, which is indicated by the arrow S. In the situation shown in Fig. 7B no vacuum is effective in the suction chamber 21' of the suction box 20', or a vacuum has been switched on, but the suction box is not yet in the running position. In the exemplifying embodiment shown in Fig. 7C, a certain vacuum is effective in the suction chamber and the wire has a certain tension. The curve form produced by means of the suction box 20' depends on the wire 10B tension and on the curve form of the deck 29' of the suction box 20'.

Fig. 8A illustrates a favourable position of a suction box 20 in accordance with the invention in a paper machine in connection with the pick-up roll 100 of the dryer section. In the figure the felt run of the press section P is denoted with the reference numeral H_{200} and the wire run of the wire part with the reference numeral H_{100}. Inside the felt loop H_{200} there is the pick-up roll 100. The pick-up roll 100 is a perforated roll, which comprises an inside suction box 101. By means of the suction, the web W is picked up from the wire H_{100} to the press section P.

As is shown in Fig. 8A, the web W is passed along with the wire H_2 and transferred by means of the suction of the pick-up roll to the dryer section in the way shown in the figure. The location of the suction box 20 shown in the figure is advantageous, because the run of the web W can be supported by means of the pick-up roll. The following advantages are obtained:

— By means of the open roll 100, the lateral areas can be supported and sealed and, when a situation of disturbance occurs (the suction is lost), the wire

cannot become slack abruptly. Even when the suction is lost, the operation can be continued normally.

- When the suction box is placed in connection with the pick-up roll 100, no extra roll is needed.
- The location of the suction box 20 permits separation of the web W from the wire H_{100} directly after the suction box 20, in which case rewetting of the web W is minimized.
- By means of an arrangement of equipment in accordance with the invention, a maximal level of dry solids content is achieved without wearing the wire H_{100}.

Fig. 8B illustrates a favourable mode of operation of the suction box 20 in accordance with the invention in said position shown in Fig. 8A. It has been possible to position the ribs on the suction box 20 so that an air gap E remains between the ribs and the pick-up roll. In such a case, the felt H_{100} is placed apart from the web W. By means of the construction, unnecessary wetting of the web W is prevented. In this position, when the suction box 20 has been fitted right before the suction zone S of the pick-up roll 100, the web W is passed directly after the last rib on the suction box 20, being picked up by the pick-up roll 100, to the press section P, and wetting of the web, arising from the wire H_{100}, after the suction box is prevented. In such a case the wire H_{100} is separated directly after the last rib of the suction box 20 out of connection with the web W passing to the press section P.

When the web is passed to the dryer section, the suction in the pick-up roll and the suction in the suction box can be maintained at the same time. This is not detrimental to the running of the web W. It is a further essential feature in view of the operability of the solution that the pick-up roll 100 is a perforated roll and that its mantle face, thus, forms an open roll. The suction box 20 is fitted in such a way in relation to the pick-up roll 100 that the last rib on the suction box, as viewed in the running direction of the web W, is placed exactly at the starting point of the suction zone S of the pick-up roll, or it may be placed slightly overlapping in relation to said starting point, i.e. slightly in the area of the suction sector S of the pick-up roll 100.

The position of the suction box 20 shown in Figs. 8A and 8B is also favourable in the respect that, even if the pick-up roll 100 has no suction and the suction box 20 has no suction, this is not harmful for the running of the web W.

Fig. 8C shows an embodiment of the invention in which the paper or board web W is passed into the couch pit M. In such a case, the pick-up roll 100 has no suction, whereas, correspondingly, the suction is effective in the suction box 20.

Besides in connection with the high-pressure suction box applications in the wire part, described above, the invention is also suitable for use, for example, in connection with the felt suction devices employed in the press section.

Above, the invention has been described with reference to some preferred exemplifying embodiments of same only, the invention being, however, by no means supposed to be strictly confined to the details of said embodiments. Many variations and modifications are possible within the scope of the inventive idea defined in the following patent claims.

Claims

1. A suction box in a paper machine, comprising a vacuum chamber (21,21'), a deck (29') or a number of substantially U-section holders (24) open towards the wire (10,10A,10B) or equivalent, and a number of ribs (22,22'), which have been fitted in said deck (29') or in said holders (24) so that they can be loaded against the wire (10,10A,10B) or equivalent by means of loading means (23), **characterized** in that, at least in a running situation, the deck (29') of the suction box (20,20') or the position of the ribs (22) is curved so that the wire (10,10A,10B) tension lowers the normal force which is produced by the vacuum present in the suction box (20,20') and which is effective between the wire (10,10A,10B) and the deck (29')/ribs (22).

2. A suction box as claimed in claim 1, **characterized** in that, in connection with the rib (22) of the suction box (20), there are locking means (25) for locking the rib (22) in the desired position in its holder (24) so that, by the effect of the vacuum effective in the suction box (20), when the wire (10,10A,10B) is positioned in a curved position and when the rib (22) is freed from the effect of the loading means (23), the ribs (22) have been fitted to be retracted into their holders (24), in which connection the ribs (22) can be locked in the desired position.

3. A suction box as claimed in claim 1 or 2, **characterized** in that the rib (22) is locked at a distance from the wire (10;10A;10B) or equivalent.

4. A suction box as claimed in any of the claims 1 to 3, **characterized** in that the ribs (22) can be shifted by means of the loading means (23) in the holders (24) against the wire (10,10A,10B) or equivalent.

5. A suction box as claimed in any of the claims 1 to 4, **characterized** in that the locking means (25) of the rib (22) are composed of a loading hose that can be pressurized.

6. A suction box as claimed in any of the claims 1 to 5, **characterized** in that locking ribs (33) with slanting faces, spring members (26) and seals (27) have been fitted between the rib (22) and the holder (24).

7. A suction box as claimed in any of the claims 1 to 6, **characterized** in that a sealing of the ends of the ribs (22) has been fitted at the ends of the suction box (20), which sealing is composed of a number of sealing members (31) interconnected by means of articulated joints.

8. A suction box as claimed in claim 1, **characterized** in that the deck (29') of the suction box (20') is fixed and curved.

9. A suction box as claimed in any of the claims 1 to 8, **characterized** in that the suction box (20,20') is placed stationarily in its position.

10. A suction box as claimed in any of the claims 1 to 8, **characterized** in that the suction box (20,20') can be shifted towards or away from the wire (10;10A;10B) or equivalent.

11. A suction box as claimed in any of the preceding claims, **characterized** in that the suction box (20), which is provided with adjustable ribs (22), is fitted in connection with a so-called open-faced roll provided with an inside suction box (101), preferably a pick-up roll (100), so that the felt (H_{200}) of the press section and the wire (H_{100}) of the wire part and, between them, the web (W) are passed between the ribs (22) of the suction box (20) and the pick-up roll (100).

12. A suction box as claimed in the preceding claim, **characterized** in that the last rib (22) of the suction box (20) is fitted in the area of the suction sector (S) of the pick-up roll (100) or slightly ahead of said sector, as viewed in the running direction (L_1) of the web (W), in which connection, by means of the vacuum produced in the area of the suction sector (S) of the pick-up roll (100), the web (W) can be transferred to the press section (P) into connection with the press felt (H_{200}), or in which

solution of equipment, by means of the suction in the suction box (20), the web (W) can be transferred into the couch pit (M).

13. A method in a suction box in a paper machine, wherein a vacuum is formed in the vacuum chamber (21,21') of the suction box (20,20') and, during formation of the vacuum, the deck (29') and/or the ribs (22,22') is/are pressed against the wire (10;10A;10B) or equivalent, **characterized** in that, in the method, at least in a running situation, the curve form of the deck (29') of the suction box (20,20') or of the position of the ribs (22) is such that the wire (10,10A,10B) tension lowers the normal force which is produced by the vacuum present in the suction box (20,20') and which is effective between the wire (10,10A,10B) and the deck (29')/ribs (22).

14. A method as claimed in claim 13, **characterized** in that, when the vacuum in the suction box (20) produces a positioning of the wire (10;10A;10B) or equivalent in a curved position, the ribs (22) are made free from the loading pressure produced by the loading means so that the ribs (22) are retracted into their holders (24), and that the ribs (22) are locked in the desired, preferably contact-free sealing position in relation to the wire (10;10A;10B) or equivalent.

15. A method as claimed in claim 13 or 14, **characterized** in that, in the method, the ribs (22) are loaded against the wire (10;10A;10B) in order to increase the reliability of running.

16. A method as claimed in claims 13 to 15, **characterized** in that, in the method, the suction box (20) is shifted towards or away from the wire (10;10A;10B) or equivalent so as to provide the desired inlet and outlet angles of the wire (10;10A; 10B) or equivalent.

FIG. 1A

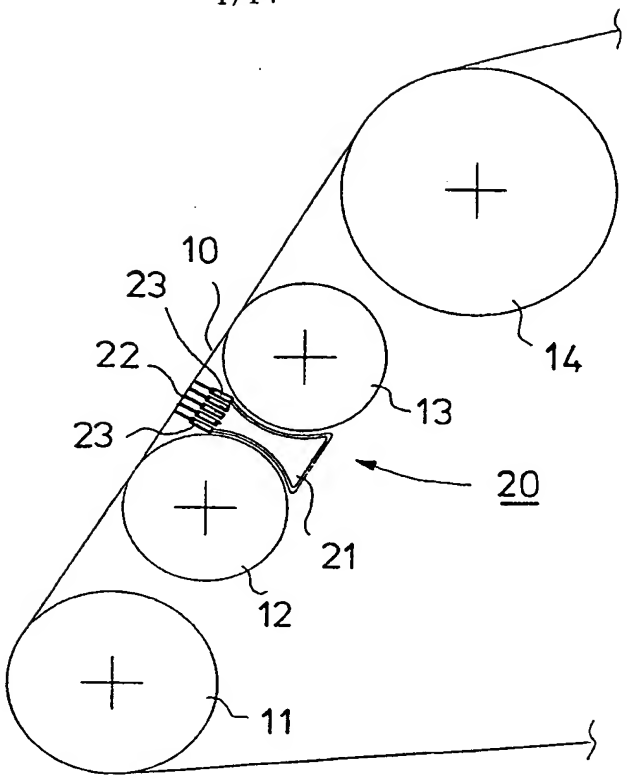


FIG. 1B

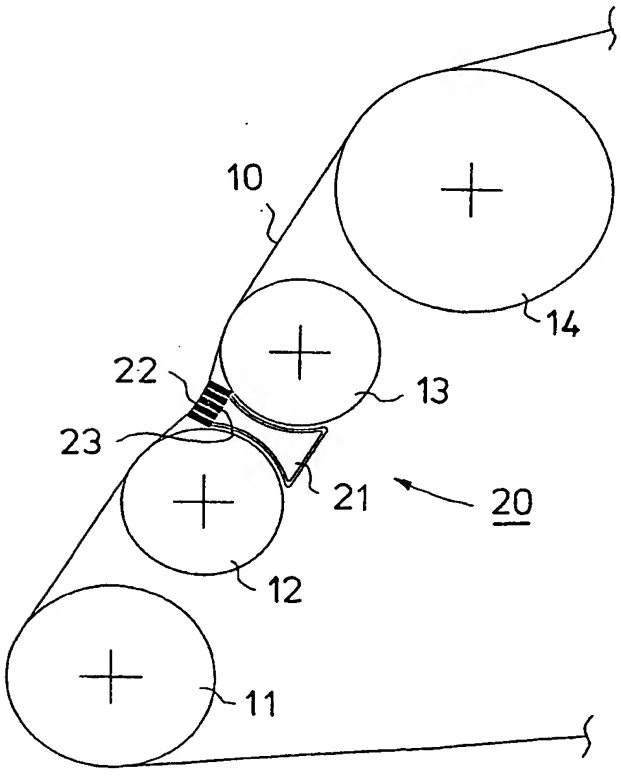


FIG. 2A

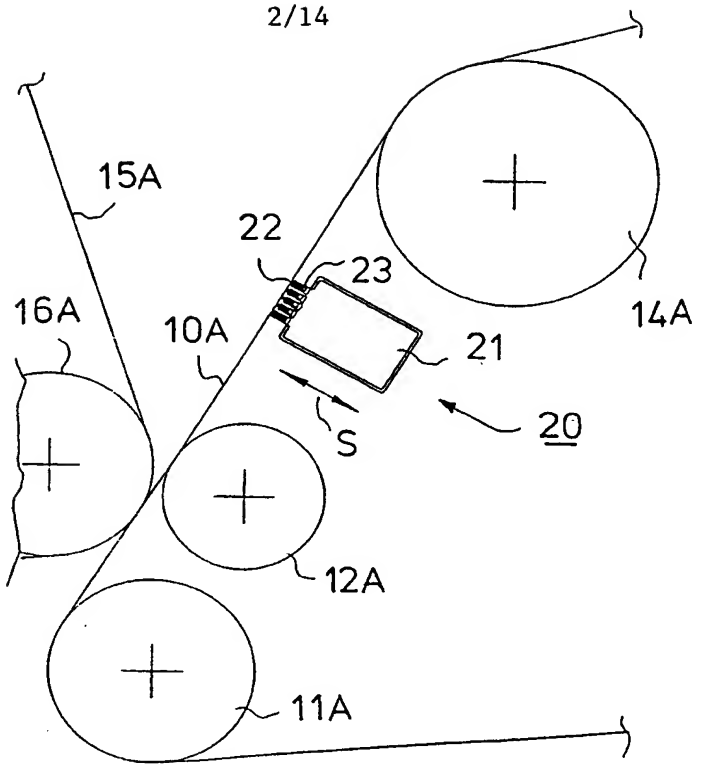
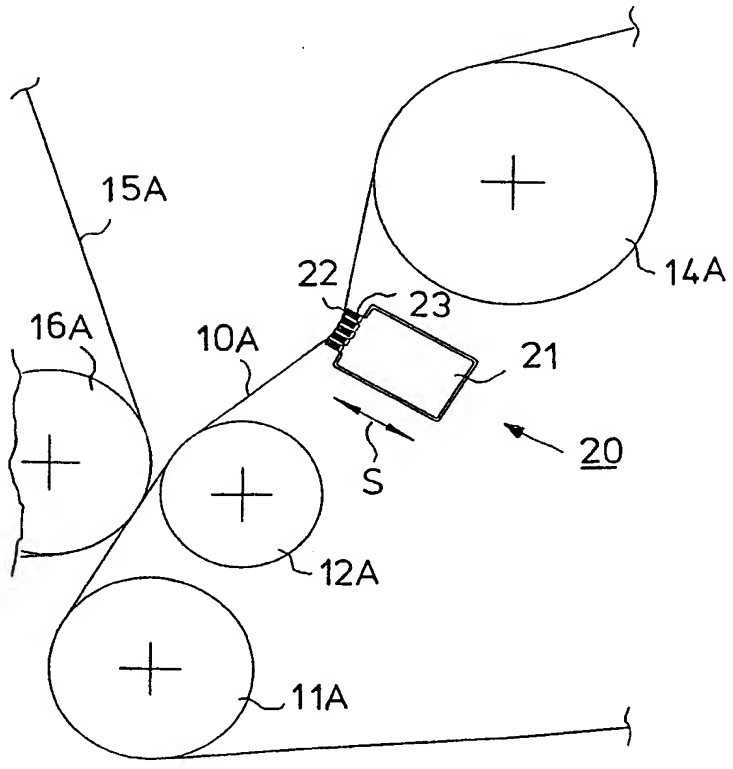

15A
22
23
16A
10A
21
14A
20
S
12A
11A

FIG. 2B


15A
14A
22
23
16A
10A
21
20
S
12A
11A

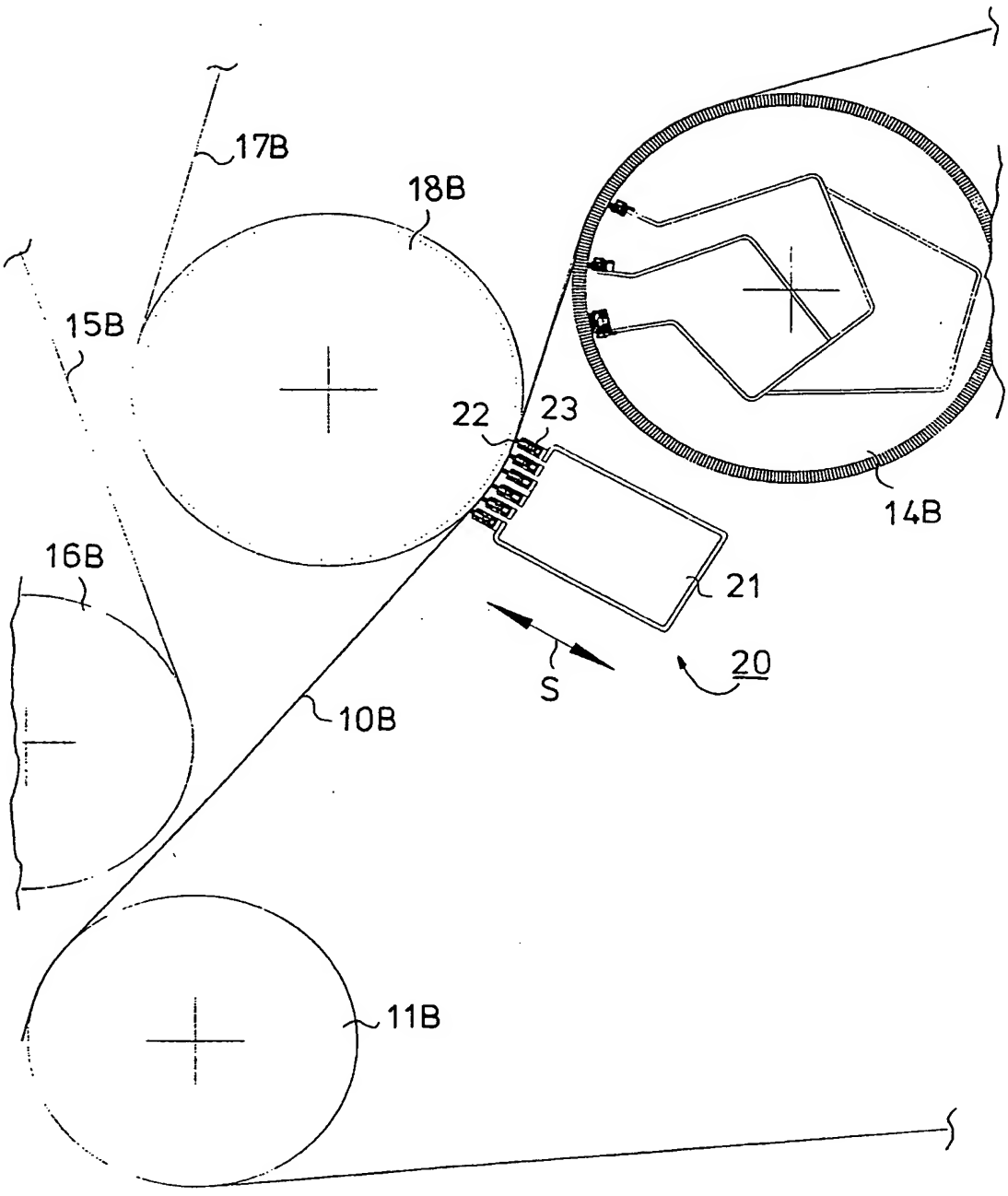


FIG. 3A

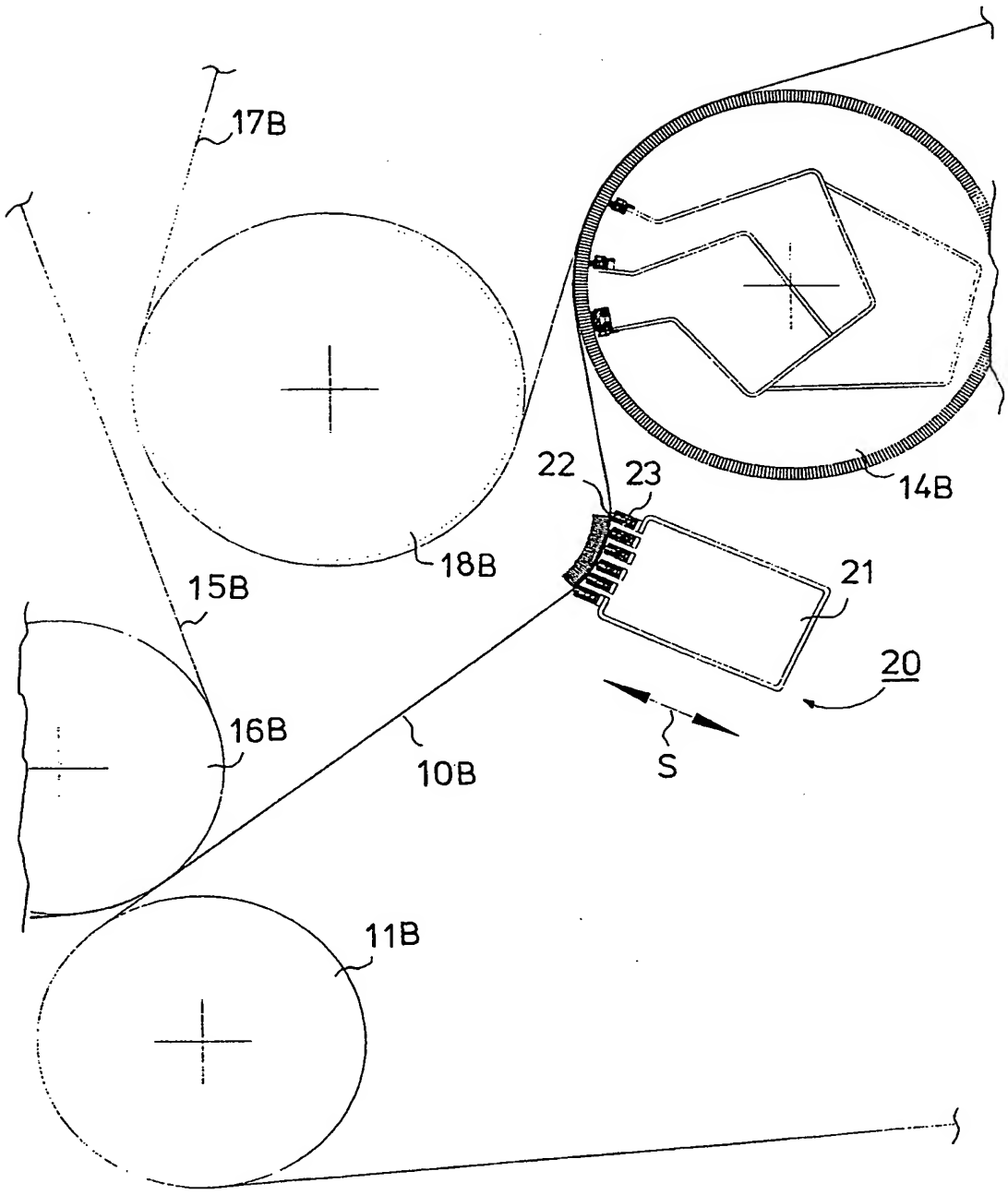


FIG. 3B

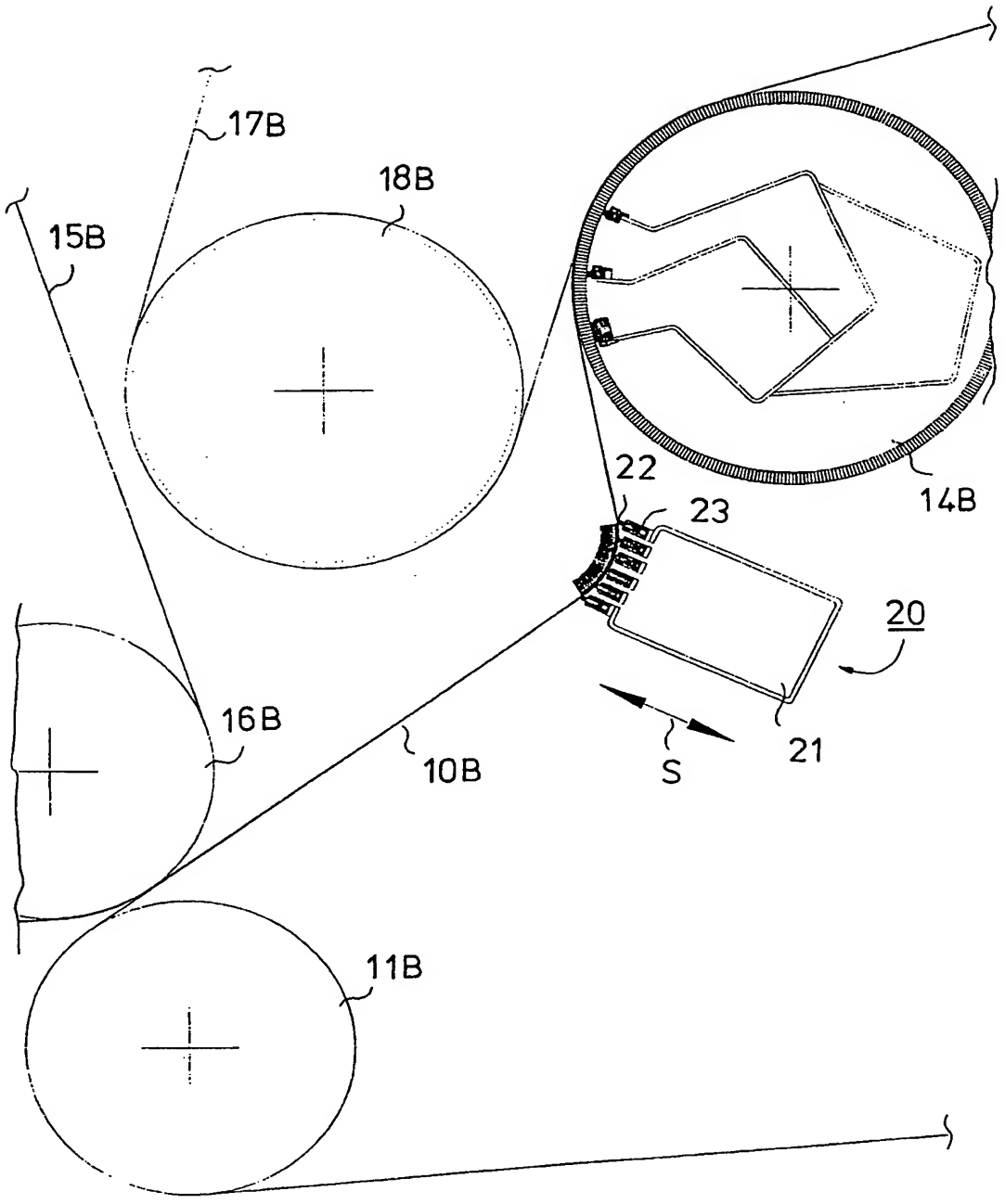


FIG. 3C

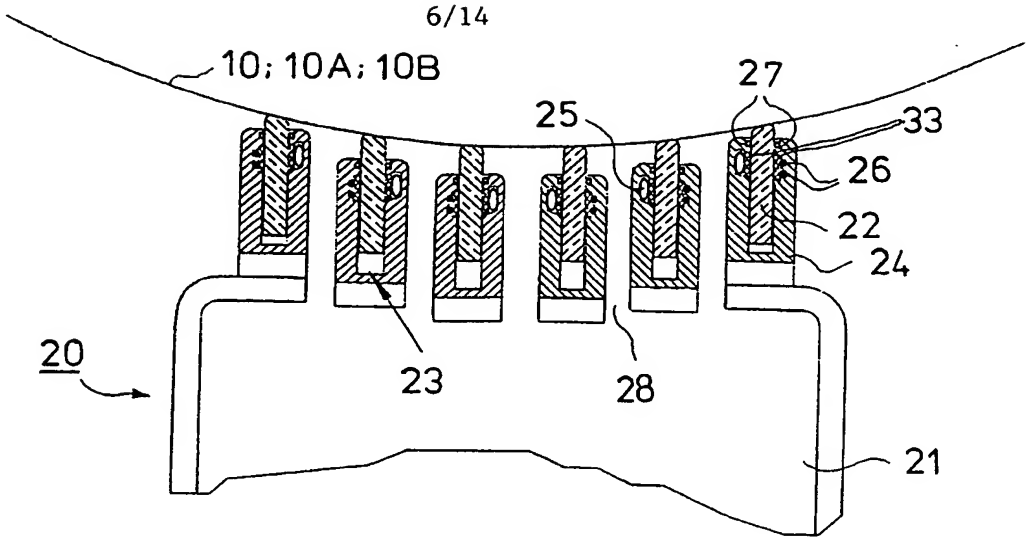

10; 10A; 10B
27
25
33
26
22
24
20
23
28
21

FIG. 4A

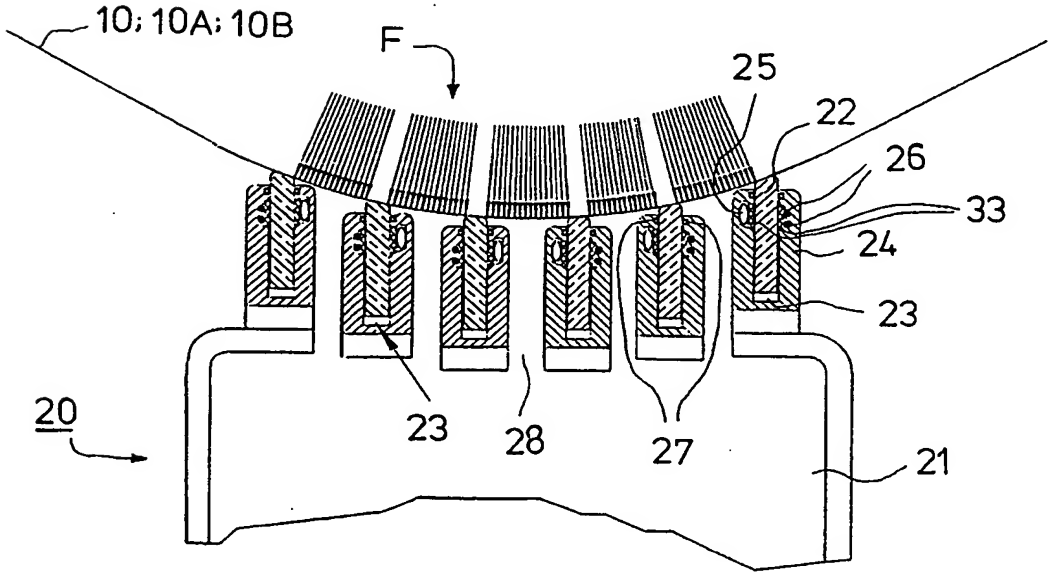

10; 10A; 10B
F
25
22
26
33
24
23
20
23
28
27
21

FIG. 4B

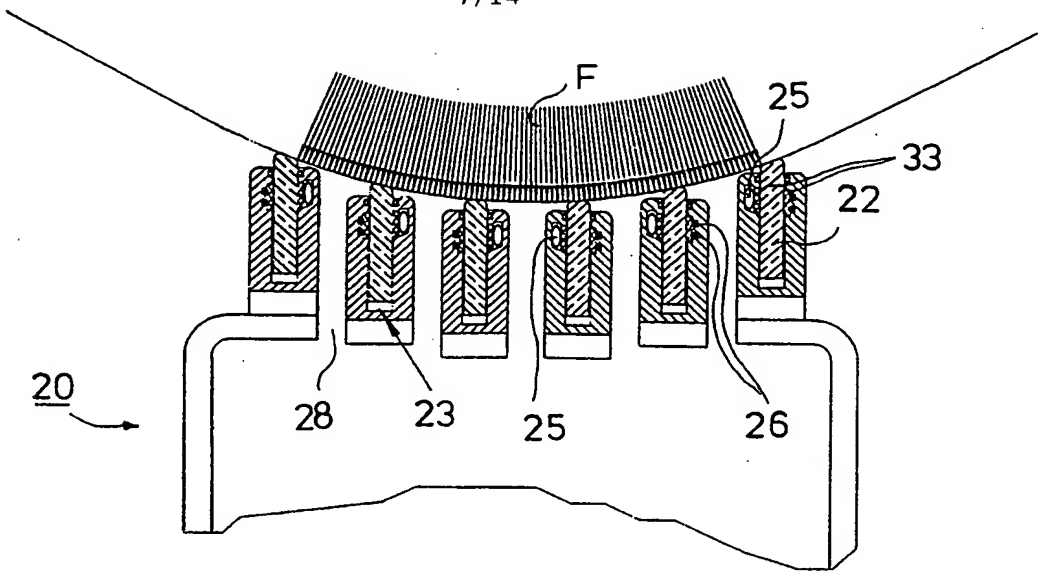


FIG. 4C

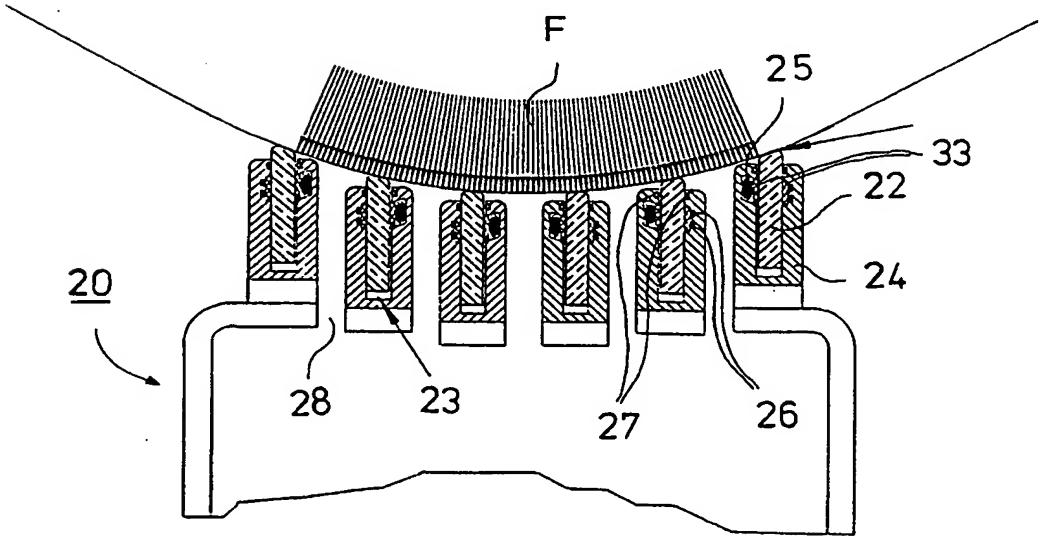


FIG. 4D

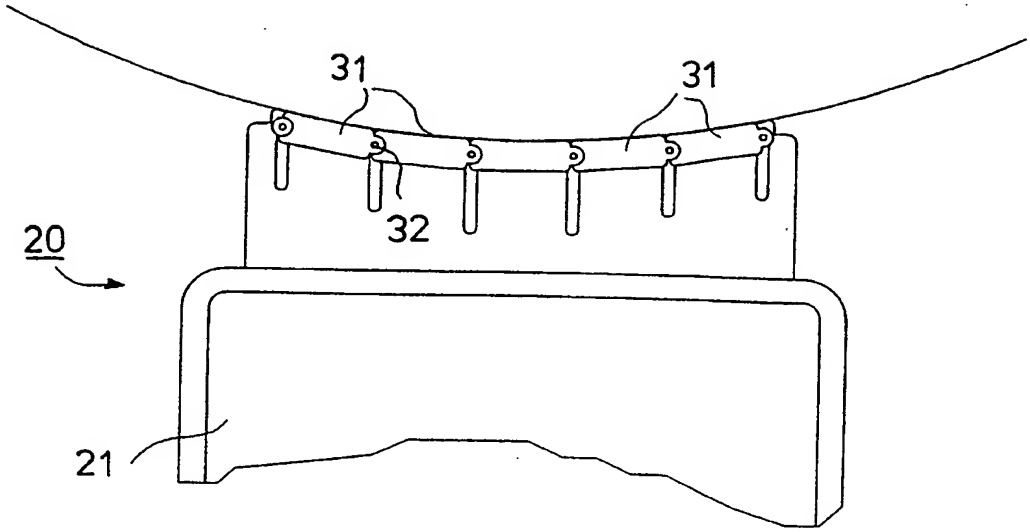


FIG. 5A

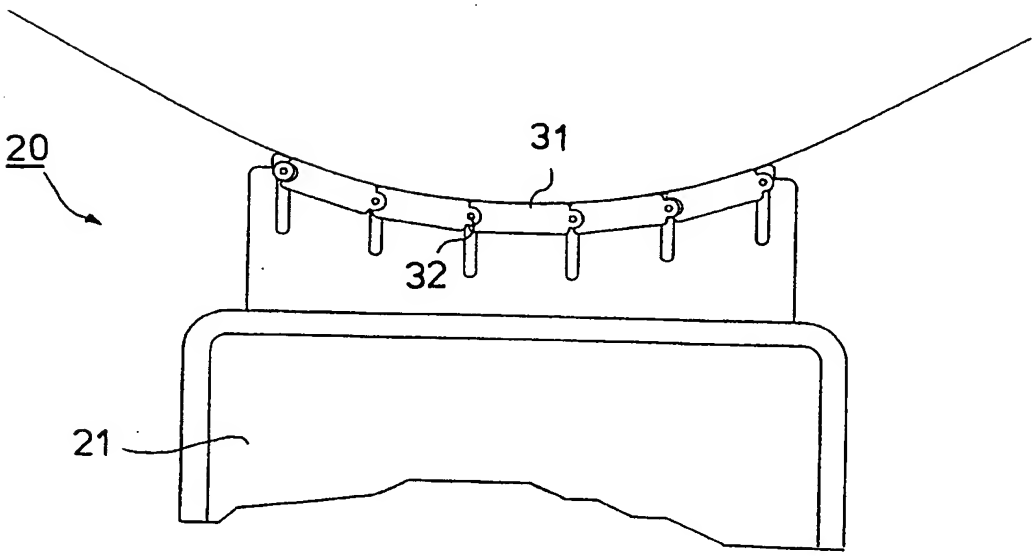


FIG. 5B

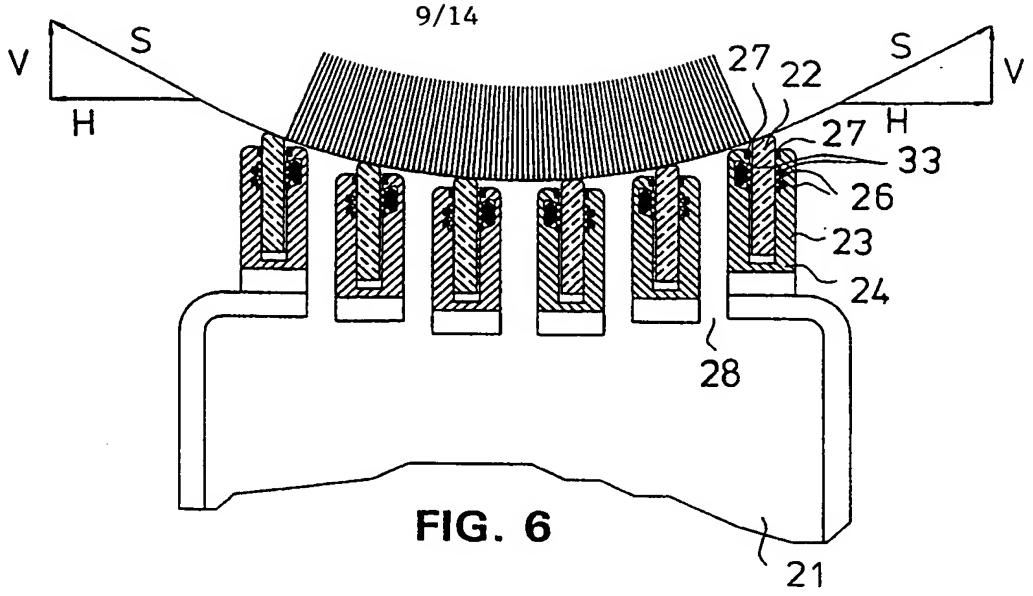


FIG. 6

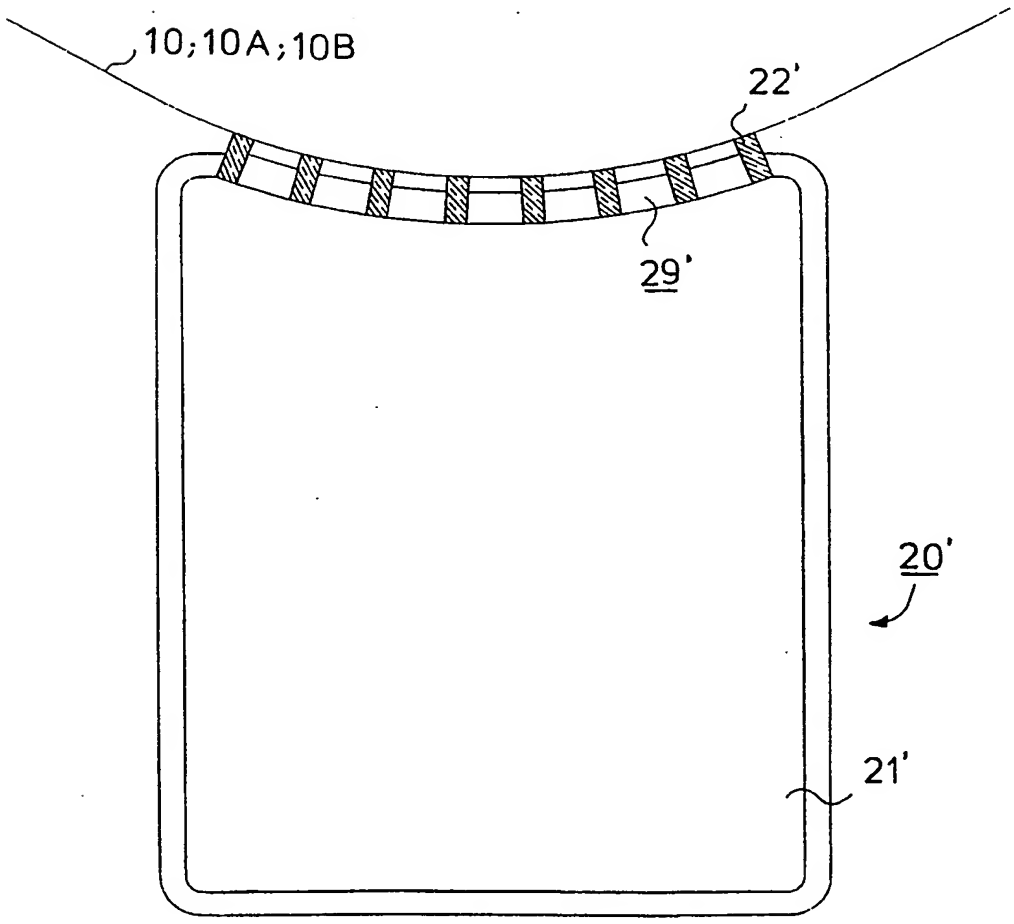


FIG. 7A

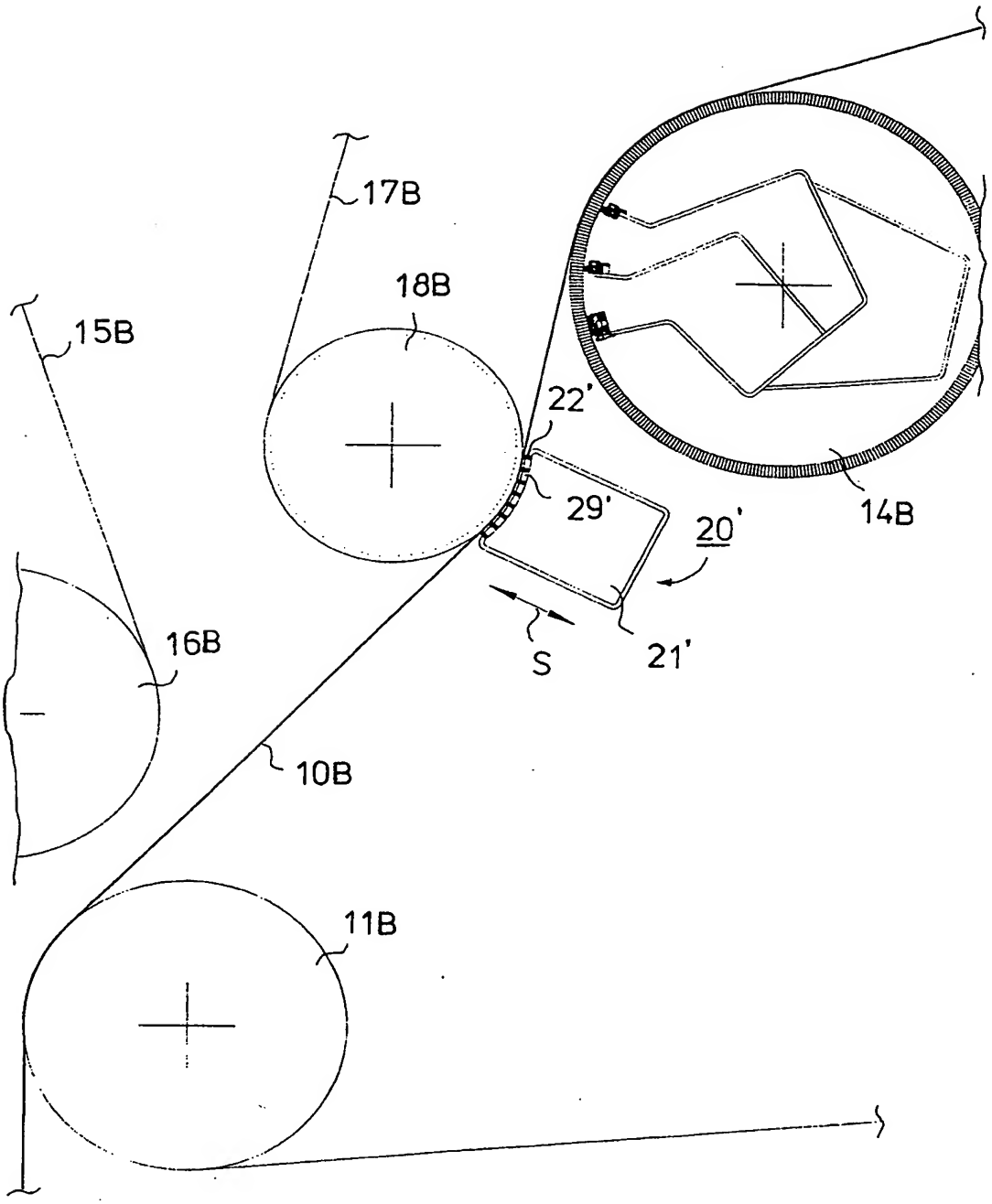


FIG. 7B

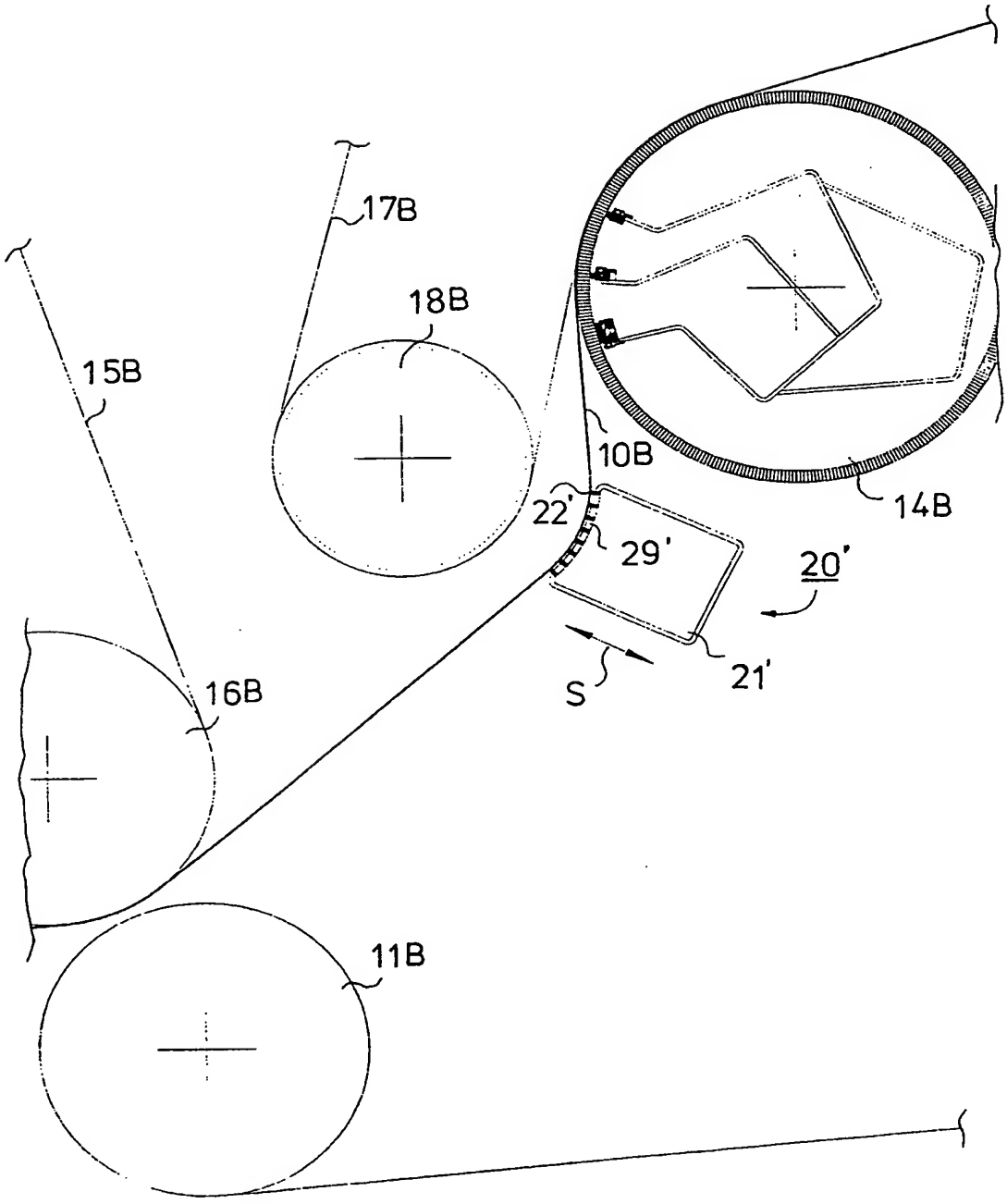


FIG. 7C

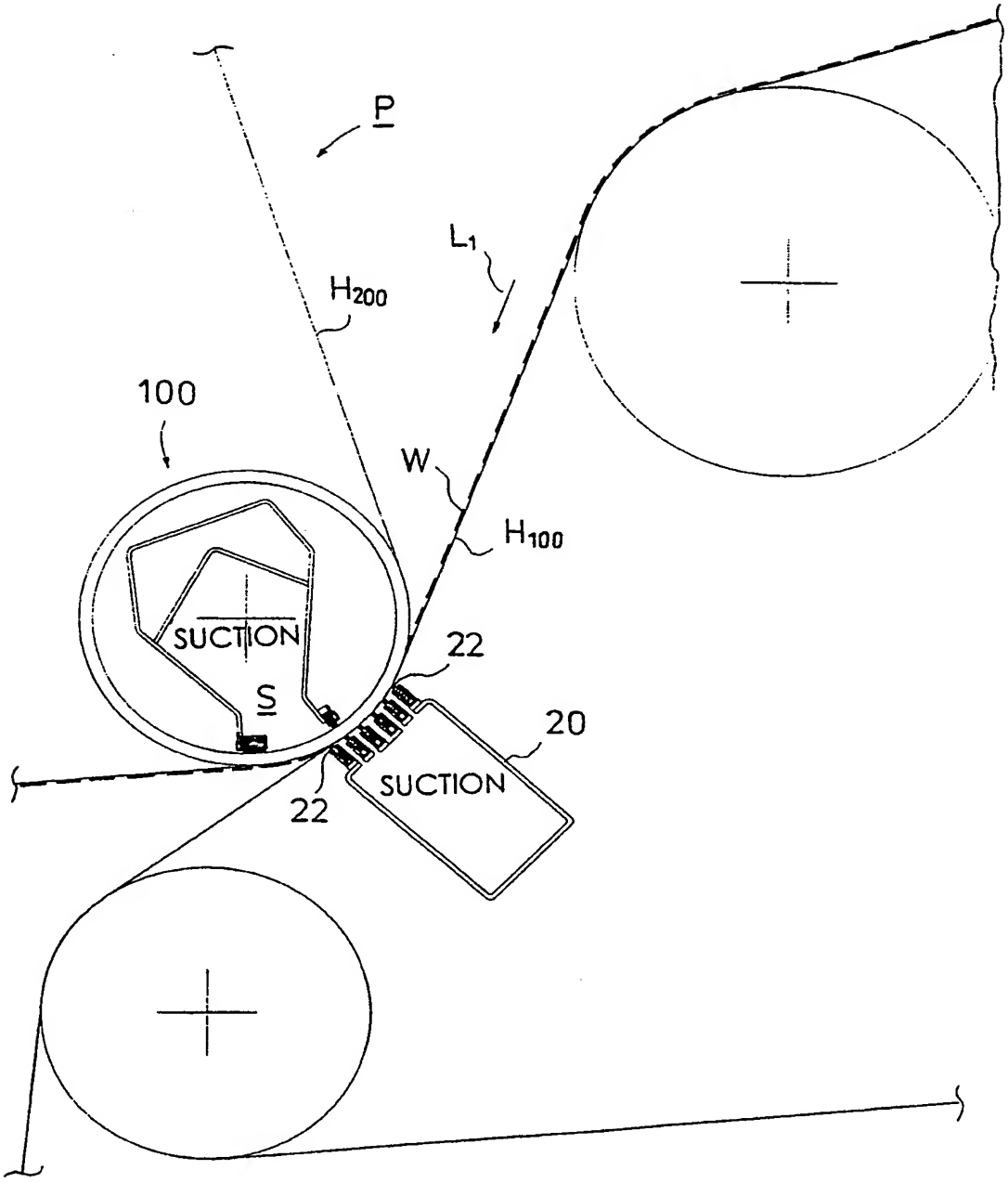


FIG. 8A

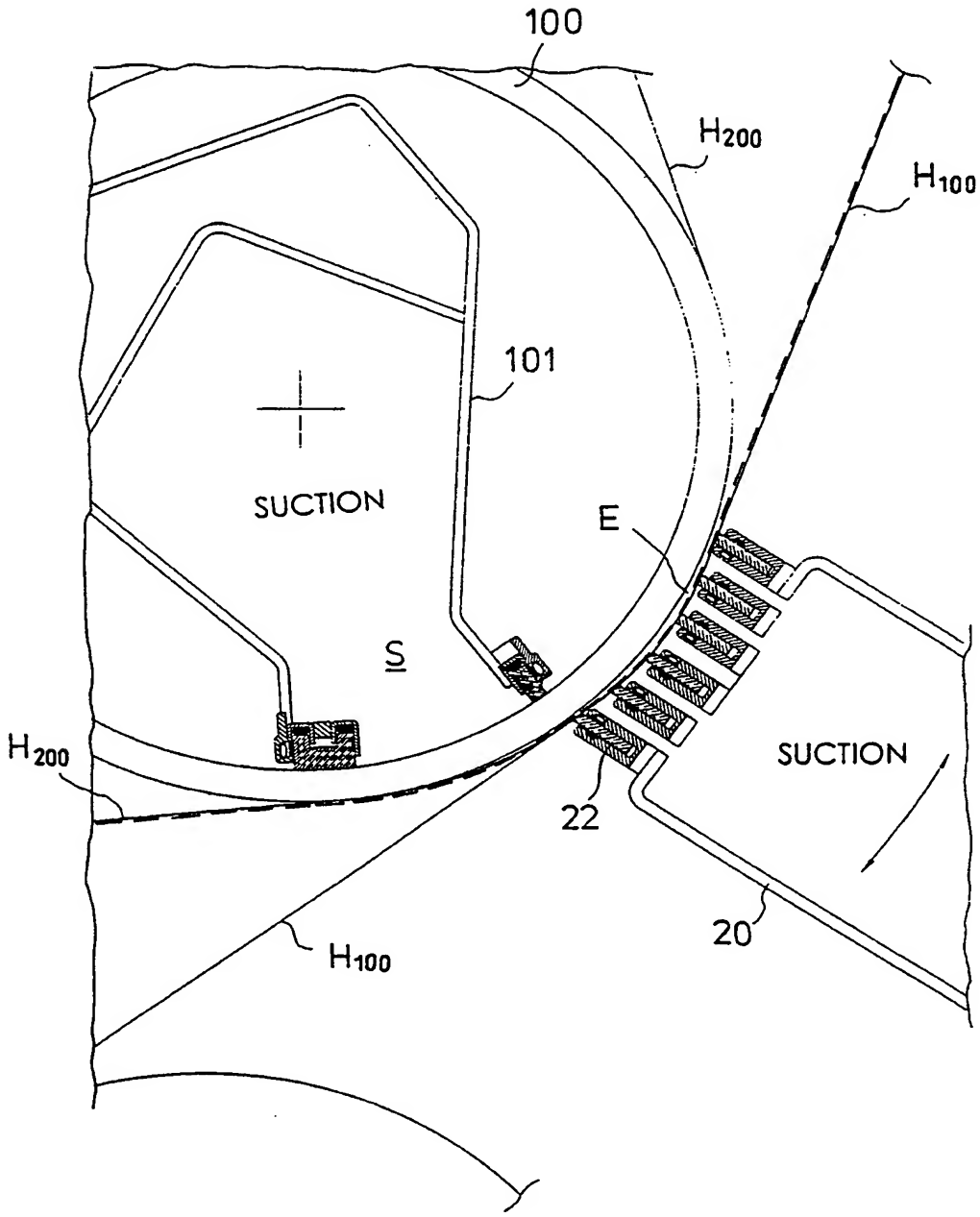


FIG. 8B

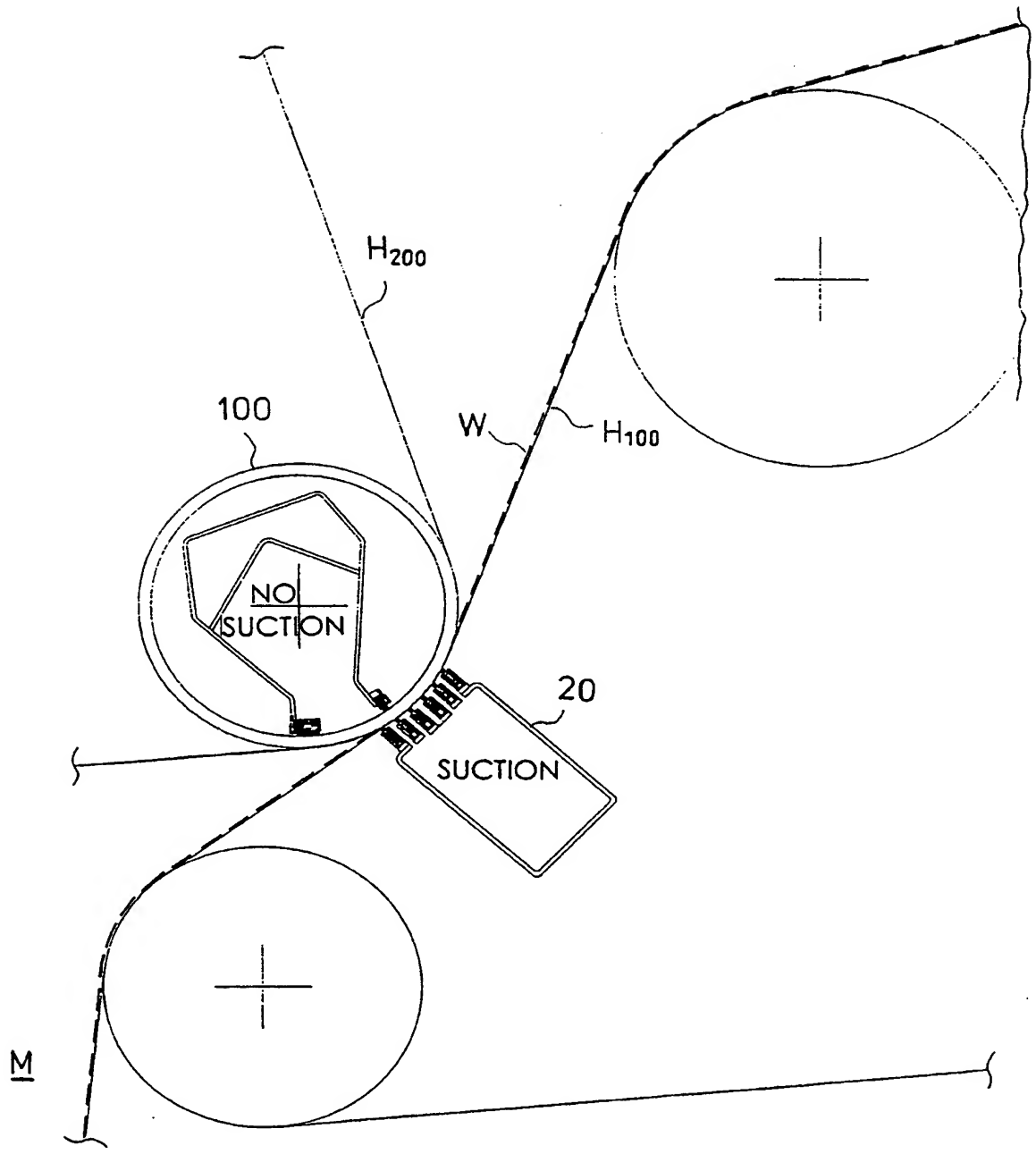


FIG. 8C

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 97/00826

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: D21F 1/52
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG: ALLSCIENCE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 4340041 A1 (J.M. VOITH GMBH), 7 April 1994 (07.04.94) --	1,13
A	US 4234382 A (CHRISTIAN SCHIEL), 18 November 1980 (18.11.80) --	1,13

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 April 1998	28-04-1998
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Olov Jensén Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

02/04/98

International application No.
PCT/FI 97/00826

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4340041 A1	07/04/94	CA 2136464 A	25/05/95
		FI 944959 A	25/05/95
		JP 7189159 A	25/07/95
		US 5681431 A	28/10/97
US 4234382 A	18/11/80	DE 2754622 A,B,C	13/06/79
		FI 783742 A	09/06/79
		GB 2009808 A	20/06/79

This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.